ASSESSING THE IMPACT OF COAL MINING ON HUMAN HEALTH AND THE ENVIRONMENT IN RAMGARH COAL MINE, JHARKHAND, INDIA: A MULTIDIMENSIONAL STUDY

SYNOPSIS Submitted
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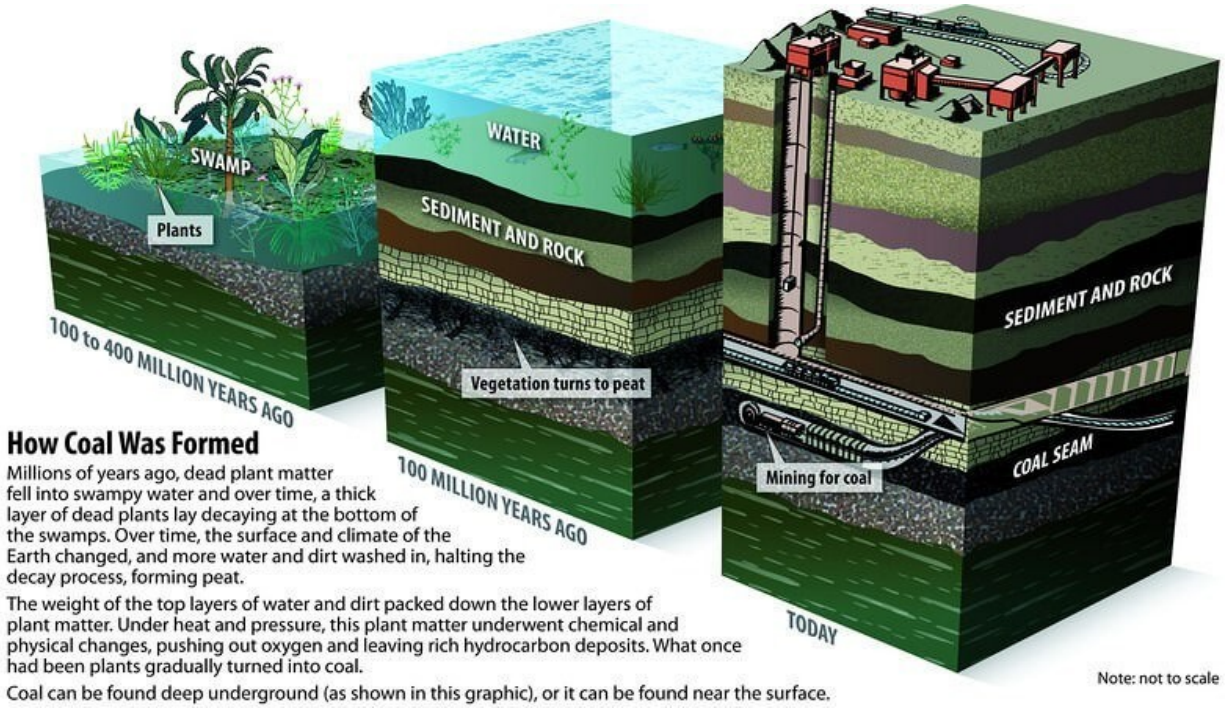
1. A brief introduction of the research topic

Coal which is commonly called as the black gold of India contributes a major part to its commercial energy production and is widely used in the power industry to generate electricity[1]. Coal has served as a fundamental pillar of global energy production for centuries, fueling industries, households, and economies. Despite its crucial role in meeting energy demands, the mining and utilization of coal have given rise to grave concerns regarding environmental degradation and public health risks[2]. Coal mining and usage significantly contribute to greenhouse gas emissions and air pollution, leading to global climate change and adverse health effects on both nearby communities and the wider population The environmental consequences of coal extraction, transportation, and combustion are extensive, affecting ecosystems, water resources, and air quality. Hence, it is essential to conduct a comprehensive and rigorous assessment of these impacts to provide valuable insights to policymakers, industries, and communities, enabling them to adopt effective mitigation strategies[2].


SWAMP
Plants
100 to 400 MILLION YEARS AGO
WATER
SEDIMENT AND ROCK
Vegetation turns to peat
100 MILLION YEARS AGO
SEDIMENT AND ROCK
Mining for coal
COAL SEAM
TODAY
Note: not to scale
How Coal Was Formed
Millions of years ago, dead plant matter fell into swampy water and over time, a thick layer of dead plants lay decaying at the bottom of the swamps. Over time, the surface and climate of the Earth changed, and more water and dirt washed in, halting the decay process, forming peat.
The weight of the top layers of water and dirt packed down the lower layers of plant matter. Under heat and pressure, this plant matter underwent chemical and physical changes, pushing out oxygen and leaving rich hydrocarbon deposits. What once had been plants gradually turned into coal.
Coal can be found deep underground (as shown in this graphic), or it can be found near the surface.

Source: https://lotusarise.com/coal-reserves-in-india-upsc/ [13]

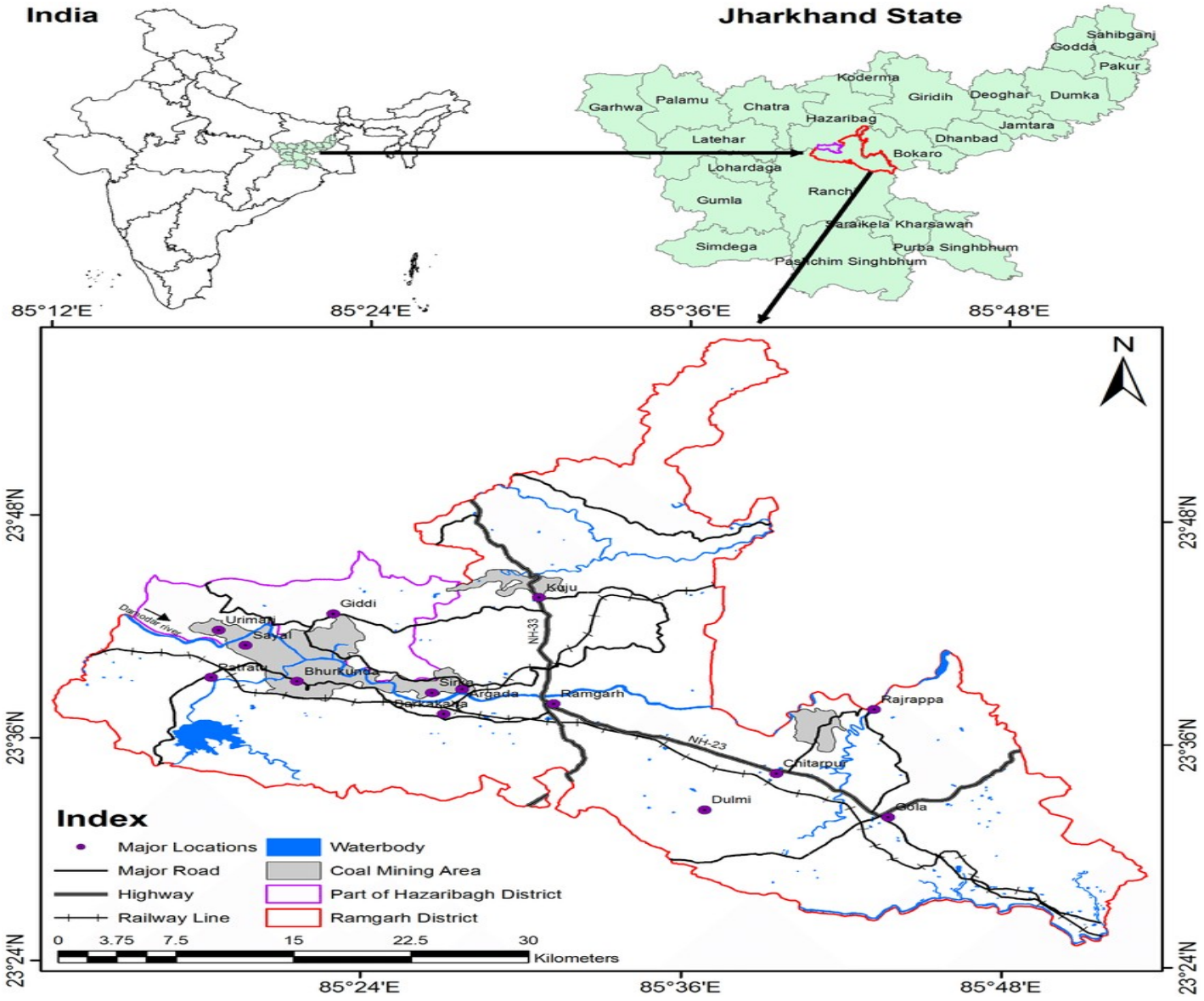
2. State of Art

Ramgarh, Jharkhand, is renowned for its coal mining industry, which significantly contributes to India's energy sector. However, the rapid expansion of coal mining activities has raised concerns about its environmental and health impacts. Recent advancements in research have improved our understanding of the environmental and health impacts of coal mining, as well as the development of mitigation strategies and regulatory measures to address these issues.
The long-term and continuous mining of coal deteriorates the natural environment as it sheds negative influences on the nearby water bodies and soil[3].The opencast mines are the major producer of fugitive dust to the air which ultimately pollutes the air environment [3]During drilling, blasting, sizing, and transportation, the release of total suspended particulate (TSP) matter and inhalable particulate matter (PM10) is the reason of air pollution in and around the mining zone[3].More specifically, the release of chemical particles with the wastewater is the reason behind alteration of water regimes. Above all the chemical particles, contamination of water through acid mine drainage is the reason behind the alteration of pH balance[3].Low pH condition is very hazardous for mankind. Due to coal mining both surface and groundwater is effected. During mining there is the release of obnoxious substances such as ash, oil, phosphorus, ammonia, urea, and acids are contaminating the surface water quality of the mining regions[3]. The presence of metallic substances in water resulting in various health hazards such as rheumatism, speech and hearing disability, euphoria, impotency, high blood pressure, high cholesterol, diabetes, kidney stones, and cancer [3].
Noise pollution is also a major problem like at the time of blasting, drilling, and transportation is polluting the entire environment[3]. Innovative technologies, such as cleaner coal technologies, mine reclamation techniques, and renewable energy alternatives, offer potential solutions to minimize the adverse effects of coal mining on the environment and human health.

2.1 Location of the area

The Ramgarh coalfield is located in the Ramgarh district of Jharkhand, India, situated within the Damodar Valley Basin between latitudes 23°35′53″N -23.59806°N and longitudes 85°40′34″E- 85.67611°E and covers an area of 98 square kilometers, which is one of the most important coal-bearing basins in India. The present boundary of Ramgarh district is in North – Hazaribagh district, South – Ranchi district, East – Ranchi and West - Bokaro district. It is situated on National Highway 33 and 46 Km away from

state's capital, Ranchi on Northern side and 52 Km away from Hazaribagh on southern side. The total area of Ramgarh district is 1341 sq.km. The Ramgarh district is a part of Chotanagpur plateau. Important physiographic regions of the district are Damodar valley. Major area of the district comes under Damodar valley. Damodar Valley is bounded by Hazaribagh plateau in north and Ranchi plateau in south[11,16].



location map of the study area showing coal mining regions along with major sites[12]

Source: https://www.pmfias.com/coal-in-india-gondwana-coal-tertiary-coal-coking-coal-non- coking-coal/ [14]

2.2 Geology and stratigraphic sequence

The coal deposits are primarily found within the Barakar Formation, which is part of the Lower Gondwana Group. The Barakar Formation consists of sedimentary rocks such as sandstone, shale, and coal seams, which were deposited during the Permian period. The stratigraphic sequence on rightside[16]. The coal seams are of bituminous coal, which is the most

Age	Formation	Sedimentary characters
Middle Permian	Barren Measures	Brown to gray, medium to fine, lenticular channel shaped sandstone bodies, overlain by red, green and carbonaceous shale; the sequence occurs repeatedly in cyclical order
Early Permian	Barakar	Buff, gray, coarse, medium and fine grained sandstone; overlying fine clastics include shale, siltstone and coal which are thick and persistent in the middle and upper parts. The sandstone, shale and coal occur as fining upward cycles
Early Permian	Karharbari	Conglomeratic, pebbly, coarse and medium grained coalescing sandstone bodies; associated fine clastics and coal beds, thin, and locally thick and persistent
Early Permian-Late Carboniferous	Talchir	Thin lenses of massive and stratified tillite, associated with thin massive and cross-bedded green sandstone and laminated

common type of coal found. Major part of the area covers granite gneiss and Gondwana rocks. Ground water is occurs in unconfined in the weathered zone of the granitic gneiss and semi-confined to unconfined in the shale, sand and coal bearing area of Gondwana rocks formations[15].

2.3 Hydrogeology and drainage

Geomorphology of the study area is undulating and weatherd pediplain means these are developed over granite gneiss and Meta sediments. High frequencies of lineaments are found. Other structures like upland dissected, structural hills, denudation hills, etc. are also found in scattered form. The hydrogeological condition of the district is very complicated due to wide variability of geology, topography, drainage and mining activity. Mainly dendritic drainage is found with influent seepages from canal, streams and other surface water bodies, contributes to the Ground water. The lower Gondwana groups of sedimentary strata including the coal bearing beds were deposited over Archean rocks in slowly sinking faulted trough (basins) [15].

2.4 Literature review

Sujata Upgupta and Prasoon Kumar Singh (2017) Impacts of Coal mining: a Review of Methods and Parameters Used in India[1]. P. Gopinathan · T. Subramani · Sofa Barbosa ·(2023) Divya Yuvaraj Environmental impact and health risk assessment due to coal mining and utilization[2]. Niharranjan Mishra1 and Nabanita Das2 (2017) Coal Mining and Local Environment: A Study in Talcher Coalfield of India[3]. Sribas Goswami (2015) Impact of Coal Mining on Environment[4]. Shashi Kant Tiwari , Lakshmi Annamalai Kumaraswamidhas and Naveen GargAssessment of noise pollution and associated subjective health complaints in Jharia Coalfield, India: A structural equation model analysis[7]. Suman Volume 34, Part 3, 2021, Pages 863-868 Air quality indices: A review of methods to interpret air quality status[8]. Atulya Kumar Mohanty, M. Lingaswamy, VVS Gurunadha Rao, S. Sankaran Impact of acid mine drainage and hydrogeochemical studies in a part of Rajrappa coal mining area of Ramgarh District, Jharkhand State of India[9].

3. Problem to be investigated

The primary problem to be investigated is the multifaceted impact of coal mining on the environment and health of the communities in Ramgarh.

- To estimate the air quality
- to estimate the ground water and the surface water quality
- to test the geochemical nature of soil
- to study geo-morphological analysis (topography and drainage pattern)
- Geological analysis (structural features-faults, joints, fractures, etc.)
- to estimate water quality index(WQI)
- to calculate the noise pollution
- assessment of various factors causing air, soil, noise and water pollution and upto what percent contributed by coal mining activities
- effect of these pollution on public health

4.Objectives of investigation and motivation

a. To assess the environmental degradation caused by coal mining activities, including air and water pollution, deforestation, and land degradation.

b. To evaluate the health implications for the local population due to exposure to coal dust, pollutants, and other hazardous substances.

c. To make a detail study on the effect of coal mining in an area which may be use in future assessment and analysis for the impact of coal mining in any area.

The motivation behind pursuing a Ph.D. in the impact of coal mining offers a chance to make a meaningful contribution to addressing pressing environmental and health challenges. Research on the impact of coal mining has broad relevance and can contribute to global efforts to transition to cleaner energy sources and mitigate environmental degradation. It will aid in shaping policies related to natural resource management and mining, environmental regulation, and sustainable development by influencing policy decisions at local, national, and international levels. It will also address the challenges faced by communities living around mining area and contribute to improving their living conditions.

5. Research hypothesis

The extensive coal mining activities in Ramgarh, Jharkhand, India, have significant environmental, social, and health impacts on the local communities and ecosystem.

1.Environmental Impact Hypothesis: Coal mining activities, lead to significant environmental degradation, including air and water pollution, deforestation, and land degradation, acid mine drainage. Analysis of the natural soil and water to assess pollutant absorption capacity. Air quality index (AQI) will be measured.

2.Health Impact Hypothesis: Coal mining activities, are associated with increased health risks among local residents due to exposure to coal dust, pollutants, heavy metals in air and water, greenhouse gases and other hazardous substances.

3.Social Impact Hypothesis: Coal mining activities in Ramgarh, Jharkhand, have substantial socioeconomic impacts, including displacement, loss of livelihoods, drop in water table level, quality of water[17].

These hypothesis provide a framework for empirical research to investigate the impact of coal mining in Ramgarh, Jharkhand, and to evaluate the validity of assumptions regarding its environmental and health implications.

6. Research design and methodology Research Design

a. This study aims to describe and analyze the environmental and health impacts of coal mining in Ramgarh, Jharkhand by

- Literature reviews
- field study
- collections of samples
- photography

b. Data will be collected at a specific point from time to time to provide insights into the current and changing state of affairs regarding coal mining impacts.
c. Combining qualitative and quantitative methods to capture the multifaceted nature of coal mining impacts comprehensively.

Methodology

1. Health impact assessment
2. Air Quality Monitoring: dust, harmful gases, noise.
3. Water Quality Monitoring: surface water and water released upstream and downstream of near mining activities will be collected and analyzed.
4. Soil samples analysis will be done and plant samples too if necessary.
5. Coal samples inorganic substance analyze before and after, so to get idea how much release in water and absorb in soil.
6. Ecological survey: In ecological surveys the impact of coal mining on terrestrial and aquatic ecosystems by examining changes in biodiversity[11], habitat loss, soil quality[17], and ecosystem functioning will be assessed.

- **Collection of samples:**

- All the samples will be collected, processed, and preserved within clean, enclosed chambers.
- While coal sampling random sampling method will be preferred.
- Water samples will be collected in 1000ml or 500ml distilled polythene bottles keeping the note of elevation also from where sample is collected [5,6]
- some parameter is tested on-site like temperature, conductivity, pH, odour, noise decibel unit [7]
- soil sample will to taken from random/grid sampling method
- But during sample collection, we must remember the sample must represent the system, in time and space, intended for study. Sample integrity must be maintained.
- Locate the area on the map from where sample is collected or use Global Positioning System (GPS), and record the latitude and longitude accuracy as one second. The sketch map should contain enough detail so that the site can be found again by a person who has never visited it. [5]

- *Chemical analysis* of the samples will be done according to Indian Standard (IS).
- *Evaluation of the samples* will be done to calculate pollution caused due to coal mining.
- *Interpretations and correlations* will be done, it will help to understand the result of coal mining on environment and health.

7. Tools to be used in collection of data

In studying the impact of coal mining in Ramgarh, Jharkhand, a variety of tools and techniques can be utilized across different stages of research, including data collection, analysis, and visualization. Here are some tools commonly used in such studies:

➔ ***Geographic Information Systems (GIS):***

● GIS software like ArcGIS or Google Earth can be used to analyze spatial data related to coal mining activities, land use changes, and environmental features.
● GIS enables the visualization of mining sites, surrounding ecosystems, and the distribution of environmental parameters such as air and water quality.

➔ ***Environmental Monitoring Equipment:***

● Instruments for measuring air quality parameters (e.g., particulate matter, sulfur dioxide) and water quality parameters (e.g., pH, dissolved oxygen) are essential for conducting environmental assessments near coal mining sites.
● Portable monitoring devices such as air quality monitors and water quality testing kits enable on-site data collection and analysis.

➔ Clinometer compass
➔ Toposheet, maps
➔ Handhandled GPS
➔ Hammer
➔ camera
➔ 1000ml and 500ml plastic bottles
➔ Formal and informal data collection, resource maps, and seasonal analysis .

By leveraging these tools effectively, researchers can conduct comprehensive studies on the impact of coal mining in Ramgarh, Jharkhand, and generate valuable insights to inform policy-makers, community engagement, and sustainable resource management practices.

8. Significance of the study

The impact of coal mining in Ramgarh, Jharkhand, India, is significant and multifaceted.

- ➔ Health impact assessment will help us to assess potential health risk associated with mining activities such as exposure to dust, chemicals, noise and other hazards.
- ➔ Harmful pollutants and chemicals due to mining activities that contaminate the surface and subsurface water.
- ➔ The percentage of harmful gases release from mines and surroundings.
- ➔ Identify and quantify the presence of heavy metals ,chemicals and other contaminants in soil due to mining activities including soil fertility, loss of biodiversity and potential for soil erosion and degradation.
- ➔ Upto what extent effect of mining activities done in Ramgarh area affect the nearby regions.

9. Its relevance to present day problem and need of the society

The impact of coal mining in Ramgarh, Jharkhand, India, remains relevant to present-day problems and the needs of society in several ways:

1.Environmental Degradation: Coal mining continues to contribute to environmental degradation, including deforestation, soil erosion, and air and water pollution. Acid mine drainage and heavy metal contamination in air and water due to mining activities depleting the environment in hazardous way. Coal mining also play important role in emission of greenhouse gases.

2.Public Health: The health impacts of coal mining persist, with local communities facing respiratory diseases, skin ailments, and other health issues due to air and water pollution is due to coal mining only? As public health remains a critical concern globally.

3.Policy and Governance: The impact of coal mining underscores the importance of robust policies and governance frameworks to regulate the mining industry effectively. Strengthening environmental regulations, enforcing labor standards, and ensuring transparency and accountability in the mining sector are essential for safeguarding the communities and protecting the environment. Such studies from time to time give

them deep insight about the effect of coal mining in the specific area and thus the policies and governance can take aid from such studies.

In summary, addressing the impact of coal mining in Ramgarh, Jharkhand, India, is relevant to present-day problems and the needs of society, including environmental sustainability, public health, economic transition, and good governance. By addressing these challenges holistically and adopting a necessary change , it is possible to achieve sustainable development and improve the well-being of communities.

10. Contribution to existing knowledge

As we already know the negative impact of coal mining but these study time and again provide deep insight about the current situation in mining area Ramgarh. It will upgrade our knowledge about the changing environmental condition ,its degradation, land shift, the exact number of pollution levels which can later we correlated with standard and thus necessary steps will be taken from officials . We can say health and environment both are renewable source if right step taken at right time and this study will be one of those.

11. Future work

Future work on the impact of coal mining in Ramgarh, Jharkhand, India, could explore several avenues to deepen understanding and address ongoing challenges

1.Long-Term Environmental Monitoring: Conducting comprehensive and long-term environmental monitoring studies to assess the ongoing impact of coal mining on air and water quality, soil health, biodiversity[11,17], and ecosystem resilience. This would provide valuable data for understanding the cumulative effects of mining activities and designing effective mitigation measures.

2.Health Impact Studies: Undertaking epidemiological studies to investigate the long-term health effects of coal mining on local communities, including respiratory diseases, cardiovascular disorders, and cancer prevalence. Such studies could inform public health interventions and healthcare policies tailored to the needs of mining-affected populations.

3. It will provide a road map to future researchers fom multiple diciplines.

By focusing on these areas of future work, researchers, policymakers, and practitioners can contribute to a more comprehensive understanding of the impact of coal mining in Ramgarh, Jharkhand, India, and work towards sustainable solutions that prioritize environmental conservation, public health, social justice, and inclusive development.

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